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A Karyomorphological Study of Diploid Races of *Aucuba japonica* Thunb. (Cornaceae) in Southern Japan, to Confirm the Presence of Sex Chromosomes

Machiko TSUSAKA[a], Hiroshi IKEDA[a, b] and Takuji HOSHINO[a, b]

[a]Department of Mathematical and Environmental System Science, Graduate School of Informatics,
Okayama University of Science, 1–1, Ridai-cho. Okayama, 700-0005 JAPAN;
E-mail: ikeda@big.ous.ac.jp
[b]Department of Biosphere-Geosphere System Science, Faculty of Informatics, Okayama University of Science,
1–1, Ridai-cho, Okayama, 700-0005 JAPAN

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Tsusaka et al. (2006) found that sex chromosomes were present in diploid races of *Aucuba japonica* Thunb. from the Chugoku and Shikoku Districts of Japan. To determine whether sex chromosomes are present in diploid races of *A. japonica* over the whole range of their distribution in Japan, we carried out a karyomorphological analysis of 82 individuals from the Kyushu and Okinawa Districts. We confirmed that diploid races of *A. japonica* have sex chromosomes over their entire range of distribution in Japan.

Key words: *Aucuba japonica*, diploid race, karyomorphology, sex chromosome.

Tsusaka et al. (2006) reported that sex chromosomes were present in diploid races of *Aucuba japonica* Thunb. This phenomenon is interesting in the context of the evolutionary history of evergreen shrubs. Tsusaka et al. (2006) examined materials from Chugoku and Shikoku Districts of Japan, which represent the almost northeastern limit of their distribution. To determine whether sex chromosomes are generally present in diploid races of *A. japonica*, it is necessary to examine materials from a wider range of locations.

In this study we aimed to provide karyomorphological data on diploid races of *A. japonica* from the Kyushu and Okinawa Districts, to determine whether sex chromosomes are present in this species over its entire distribution in Japan.

Materials and Methods

Eighty-two individuals were collected from 14 localities in the Kyushu and Okinawa Districts of southern Japan (Table 1). The methods used for preparing the plant material for chromosome observation and karyomorphological analyses followed Tsusaka et al. (2006). Voucher specimens are deposited in the Herbarium of Okayama University of Science (OKAY).

Results and Discussion

Figures 1 and 2 show the somatic chromosomes and karyotypes of diploid races of *A. japonica*, respectively. After examining the chromosomes of 82 individuals collected from 14 localities in the Kyushu and Okinawa Districts, we found that all individuals were diploid, with 2n = 16 (Table 1). Eight chromosome pairs were recognized, and the smallest pair had large satellites on the short arms. This karyotype is same as that reported by Tsusaka et al. (2006).

Tsusaka et al. (2006) found that sex

Table 1. Collection data, sexualities, number of individuals examined, chromosome numbers, and karyotypes of diploid races of *Aucuba japonica*

Locality (collector, voucher specimen number, altitude)	Sex	Number of individuals examined	Chromosome number (2n)	Karyotype
Fukuoka Prefecture				
Kokuraminami, Kitakyushu-shi (M. Tsusaka 06011602, 170 m)	♂	2	16	hetero*
Saga Prefecture				
Yamato-cho, Saga-shi (M. Tsusaka 05060602, 240 m)	♂	4	16	hetero
Yamato-cho, Saga-shi (M. Tsusaka 05060602, 240 m)	♀	3	16	homo**
Nagasaki Prefecture				
Agami, Tsushima-shi (H. Manno & al. 0506070A, 100 m)	♀	3	16	homo
Fukae-cho, Minamishimabara-shi (M. Tsusaka 05060601, 310 m)	♂	5	16	hetero
Fukae-cho, Minamishimabara-shi (M. Tsusaka 05060601, 310 m)	♀	2	16	homo
Kumamoto Prefecture				
Nakamatsu, Minamiaso-mura (M. Tsusaka 05060504, 480 m)	♂	6	16	hetero
Nakamatsu, Minamiaso-mura (M. Tsusaka 05060504, 480 m)	♀	3	16	homo
Oita Prefecture				
Ume, Saiki-shi (M. Tsusaka 05060500, 200 m)	♀	3	16	homo
Kawakita, Yuhuin-cho (M. Tsusaka 05060502, 460 m)	♂	4	16	hetero
Kawakita, Yuhuin-cho (M. Tsusaka 05060502, 460 m)	♀	5	16	homo
Takeyama, Usuki-shi (M. Tsusaka 06011301, 100 m)	♂	3	16	hetero
Takeyama, Usuki-shi (M. Tsusaka 06011301, 100 m)	♀	2	16	homo
Miyazaki Prefecture				
Sanin, Togo-cho (M. Tsusaka 05060503, 20 m)	♂	2	16	hetero
Sanin, Togo-cho (M. Tsusaka 05060503, 20 m)	♀	5	16	homo
Kamisanzai, Saito-shi (M. Tsusaka 06011302, 170 m)	♂	1	16	hetero
Kagoshima Prefecture				
Mt. Choya, Kaseta-shi (H. Ikeda & N. Yamamoto 0506120A, 390 m)	♂	1	16	hetero
Mt. Choya, Kaseta-shi (H. Ikeda & N. Yamamoto 0506120A, 390 m)	♀	5	16	homo
Mochomu, Yaku-cho, Yakushima Is. (M. Tsusaka 06011401, 460 m)	♂	5	16	hetero
Mochomu, Yaku-cho, Yakushima Is. (M. Tsusaka 06011401, 460 m)	♀	5	16	homo
Mt. Yuwan, Uken-son, Amami Is. (M. Tsusaka 05122501, 550 m)	♂	6	16	hetero
Mt. Yuwan, Uken-son, Amami Is. (M. Tsusaka 05122501, 550 m)	♀	5	16	homo
Okinawa Prefecture				
Mt. Katsuu, Nago-shi (M. Tsusaka 05122301, 400 m)	♂	1	16	hetero
Mt. Katsuu, Nago-shi (M. Tsusaka 05122301, 400 m)	♀	1	16	homo

*hetero: the fourth-longest pair with heterogeneous chromosomes.
**homo: the fourth-longest pair with homogeneous chromosomes.

chromosomes were present in diploid races of *A. japonica* from the Chugoku and Shikoku Districts of Japan. They found that the fourth-longest pair of chromosomes was heterogeneous ("heterotype") in male individuals, and homogeneous ("homotype") in female individuals. In the present study, we also found that male individuals were heterotypic, and female individuals were homotypic (Table 1, Figs. 1, 2). On the basis of our observations, we inferred that this sex-dependent karyomorphological variation in diploid races of *A. japonica* is likely to be present in individuals of this species over its entire range of distribution in Japan, and that the fourth-longest pair of chromosomes could be considered sex chromosomes.

Several types of plant sex chromosomes exist (Sinoto 1929, Allen 1940, Westergaard 1958), of which the XY type (heterogeneous pair for male, and homogeneous pair for female) is most common (this type is present in, for example, *Populus* and *Salix* (Salicaceae) (Blackburn and Harrison 1924),

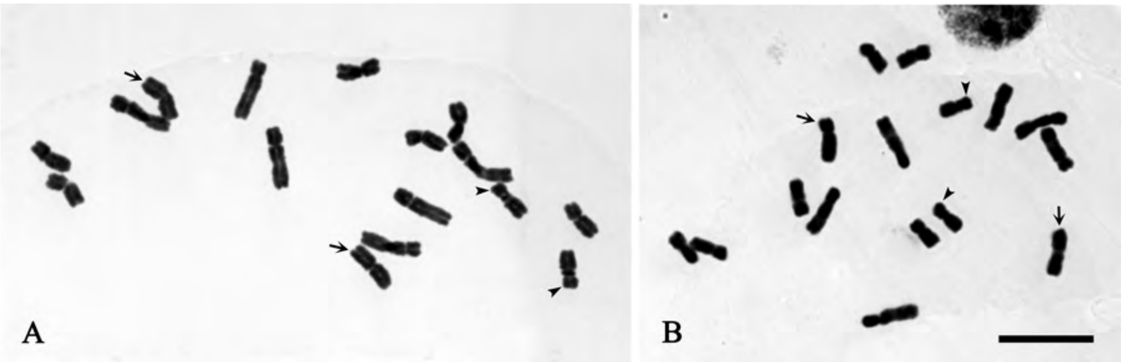

Fig. 1. Somatic chromosomes of diploid races of *Aucuba japonica*, collected from Minamiaso-mura, Kumamoto Pref. A. Female. B. Male. Arrows indicate the fourth-longest pair with homogeneous chromosomes (A) and heterogeneous chromosomes (B). Arrowheads indicate satellite chromosomes. Bar = 10 µm.

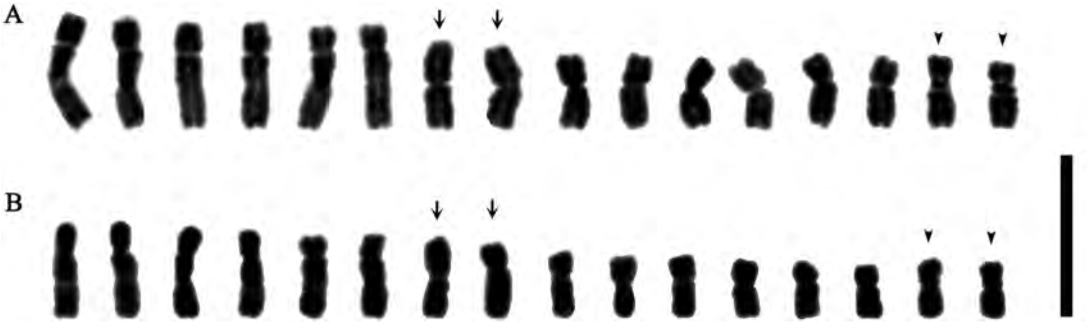

Fig. 2. Karyotypes of diploid races of *Aucuba japonica*, collected from Minamiaso-mura, Kumamoto Pref. A. Female. B. Male. Arrows indicate the fourth-longest pair with homogeneous chromosomes (A) and heterogeneous chromosomes (B). Arrowheads indicate satellite chromosomes. Bar = 10 µm.

Cannabis and *Humulus* (Cannabaceae) (Sinoto 1929, Winge 1923), *Buckleya* (Santalaceae) (Nakajima 1937), *Rumex* (Polygonaceae) (Kihara and Ono 1923, Löve 1943), *Melandrium* (Caryophyllaceae) (Blackburn 1923, Winge 1923), *Daphniphyllum* (Daphniphyllaceae), and *Trachycarpus* (Palmae) (Sinoto 1929). On the basis of our karyomorphological studies, we consider that the sex chromosomes of *A. japonica* are the XY type.

Aucuba japonica is known to have diploid and tetraploid races. To better understand the chromosomal evolution of *A. japonica*, karyomorphological studies on tetraploid races of *A. japonica*, as well as on other species of *Aucuba* are needed.

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Japanese floristic elements against to environments of Asian Islands”.

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津坂真智子[a]，池田　博[a, b]，星野卓二[a, b]：**南日本産2倍体アオキ（ミズキ科）の核形態，特に性染色体について**

Tsusaka et al. (2006)は2倍体アオキの核形態学的解析をおこない，2倍体アオキに性染色体が存在することを報告した．しかし，研究に用いた材料は，分布の北東部にあたる中国・四国地方産のものに限られていた．そこで，2倍体アオキが分布域全域にわたり性染色体を保持しているかどうかを確認するために，九州・沖縄地方産のアオキの核型を解析した．その結果，4番目に長い染色体対に中部動原体染色体を2本もつホモ型と，中部動原体染色体と次中部動原体染色体を1本ずつもつヘテロ型の組み合わせをもつ個体が見出された．ホモ型の個体はすべて雌であり，ヘテロ型の個体はすべて雄であったことから，変異を示す染色体対は性染色体であると考えられた．したがって，日本に生育する2倍体アオキは，分布域全域にわたって性染色体を保持していると考えられる．

（[a]岡山理科大学大学院総合情報研究科数理・
環境システム専攻，
[b]岡山理科大学総合情報学部
生物地球システム学科）